

US008320344B2

(12) **United States Patent**  
**Hodroj et al.**

(10) **Patent No.:** **US 8,320,344 B2**  
(45) **Date of Patent:** **Nov. 27, 2012**

(54) **SYSTEM AND METHOD FOR PROVISIONING TELECOMMUNICATIONS SERVICES BETWEEN AN ACCESS POINT AND A TELECOMMUNICATIONS NETWORK AND PROVIDING A MISSING INFORMATION NOTIFICATION**

(75) Inventors: **Samir Hodroj**, Bothell, WA (US);  
**Omar Hassan**, Kirkland, WA (US)

(73) Assignee: **T-Mobile USA, Inc.**, Bellevue, WA (US)

(\*) Notice: Subject to any disclaimer, the term of this patent is extended or adjusted under 35 U.S.C. 154(b) by 945 days.

(21) Appl. No.: **12/395,593**

(22) Filed: **Feb. 27, 2009**

(65) **Prior Publication Data**

US 2010/0220700 A1 Sep. 2, 2010

(51) **Int. Cl.**  
**H04W 4/00** (2009.01)

(52) **U.S. Cl.** ..... **370/338**

(58) **Field of Classification Search** ..... 370/328-339  
See application file for complete search history.

(56) **References Cited**

U.S. PATENT DOCUMENTS

6,493,629	B1 *	12/2002	Van Bosch	701/515
7,295,556	B2 *	11/2007	Roese et al.	370/395.3
7,433,673	B1 *	10/2008	Everson et al.	455/404.1
8,160,614	B2 *	4/2012	Shaffer et al.	455/456.3
2005/0083911	A1 *	4/2005	Grabelsky et al.	370/352
2006/0293024	A1 *	12/2006	Benco et al.	455/404.2

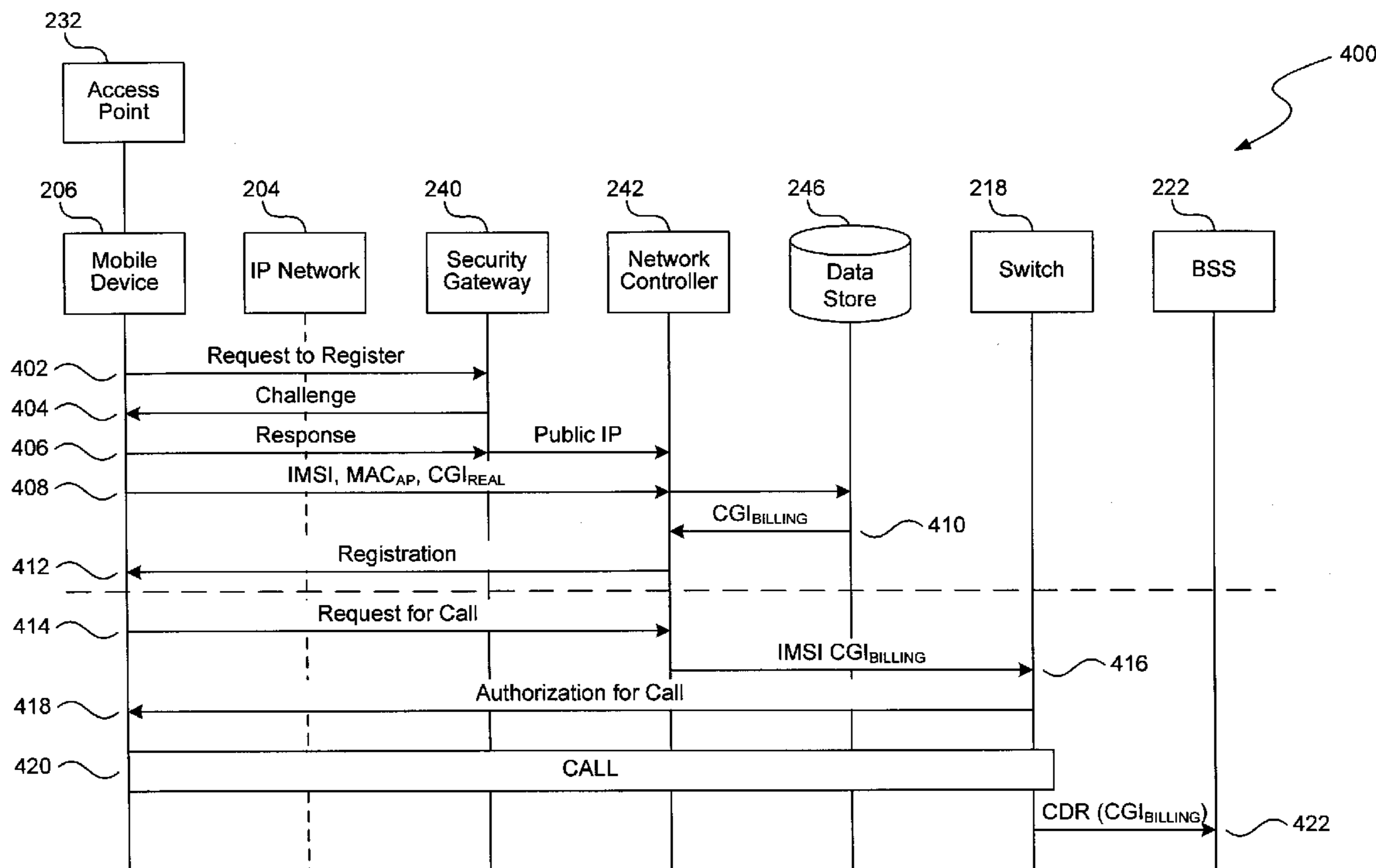
\* cited by examiner

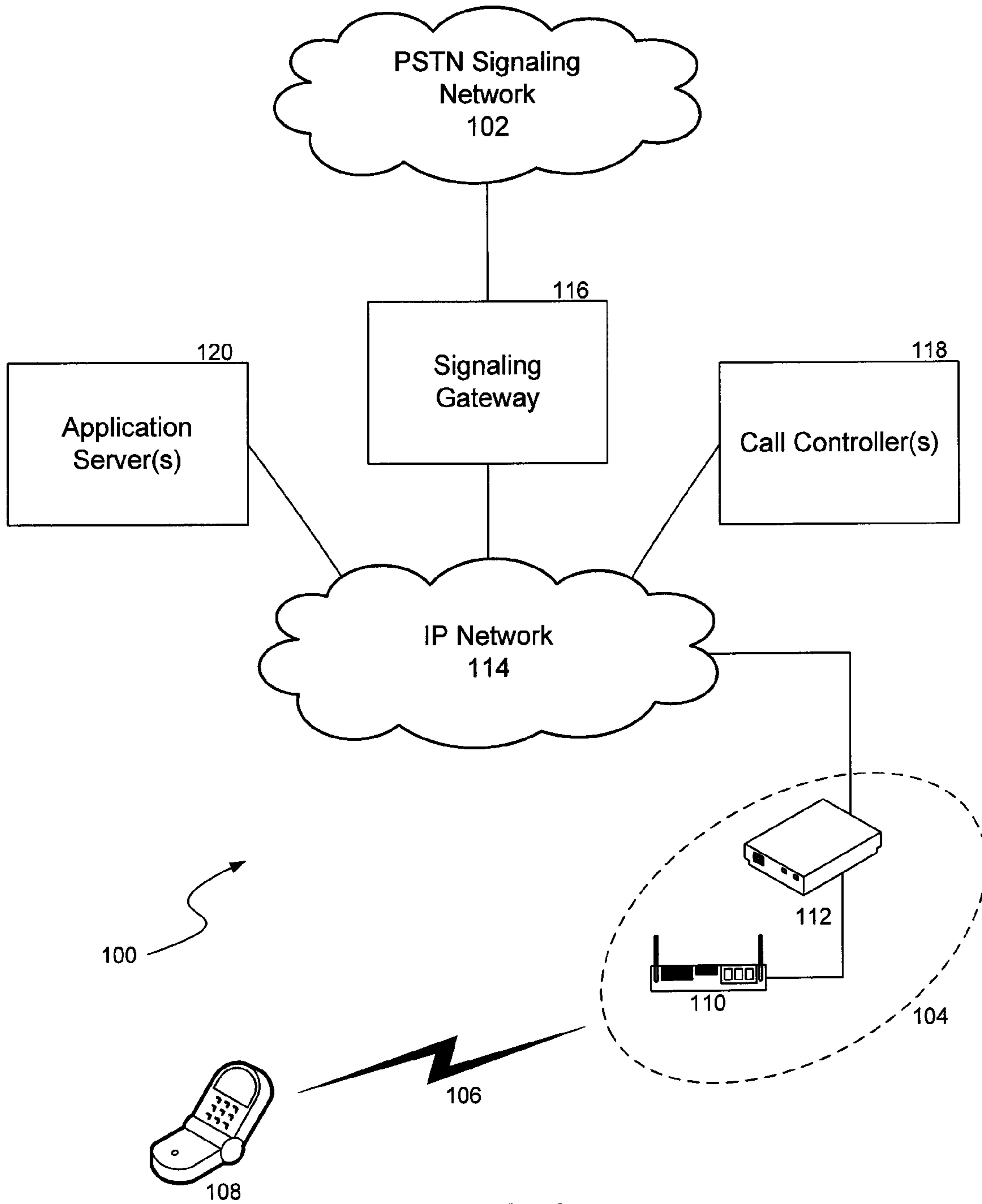
*Primary Examiner* — Frank Duong

(57) **ABSTRACT**

A method and system for selectively provisioning connections between an access point, which supports telecommunications services over an IP network, and a carrier network includes a network connection and a telephone connector suitable for connecting to a landline telephone, a cordless telephone, or a mobile device. The access point sends a provisioning request, which includes identifying information such as a subscriber identifier and a MAC address, to a network controller. The network controller attempts to find a geographic, street, or other address associated with the connection to be provisioned. If an address is not found, the network controller rejects the connection and sends a missing information notification to the access point. After receiving the missing information notification, the access point controls a user indicator to provide error information.

**22 Claims, 8 Drawing Sheets**





**FIG. 1**

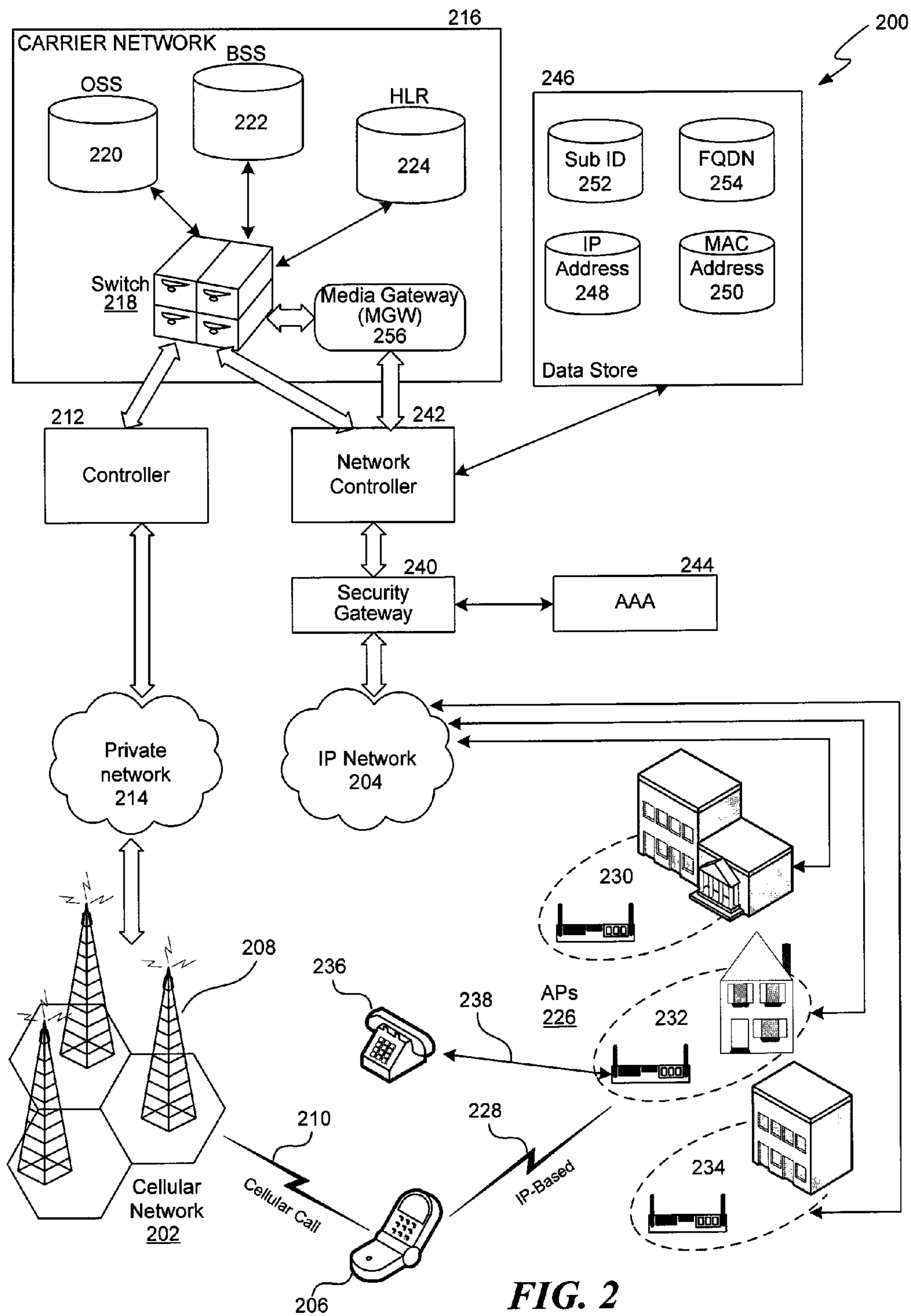
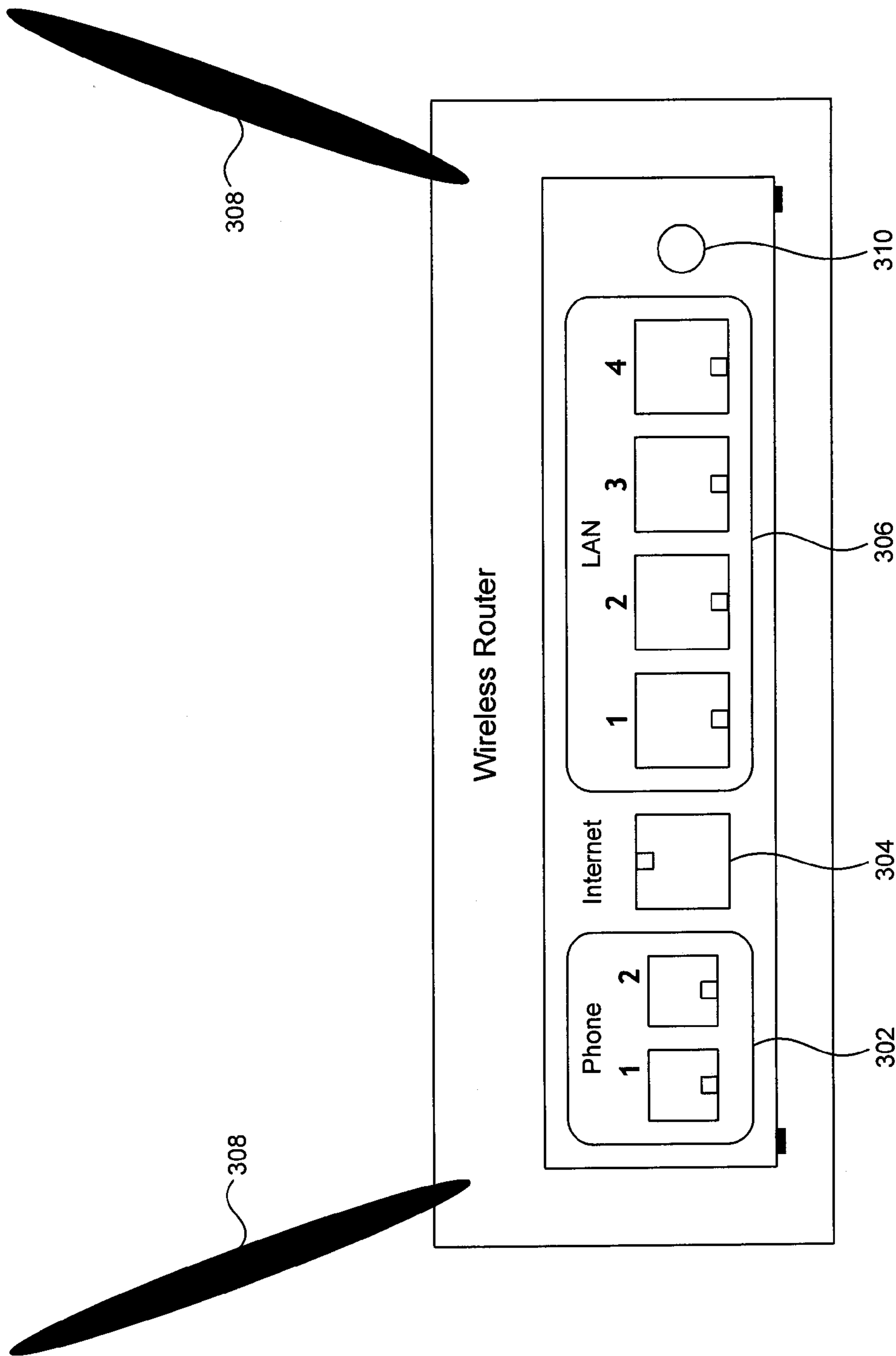


FIG. 2



226

**FIG. 3**

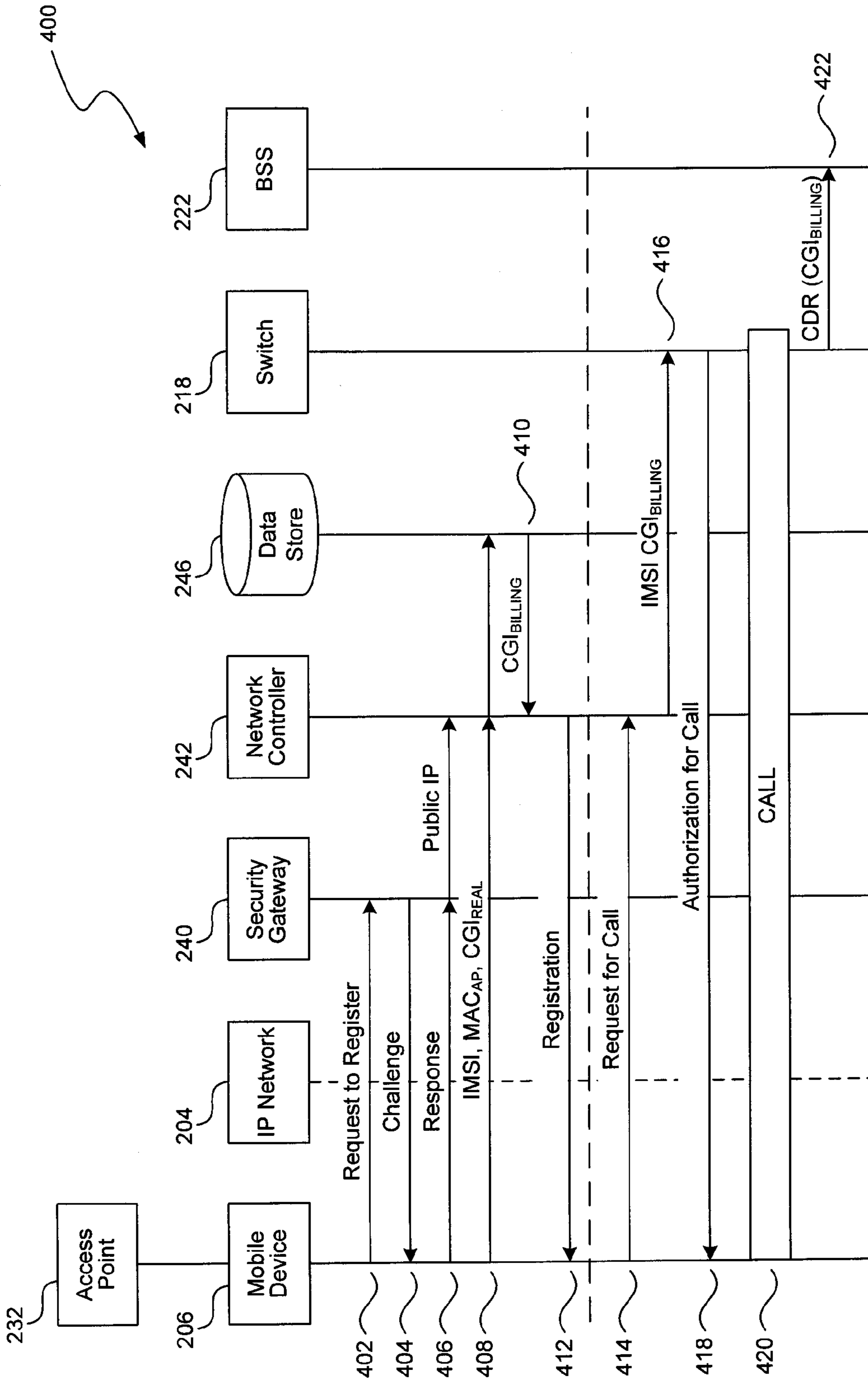


FIG. 4

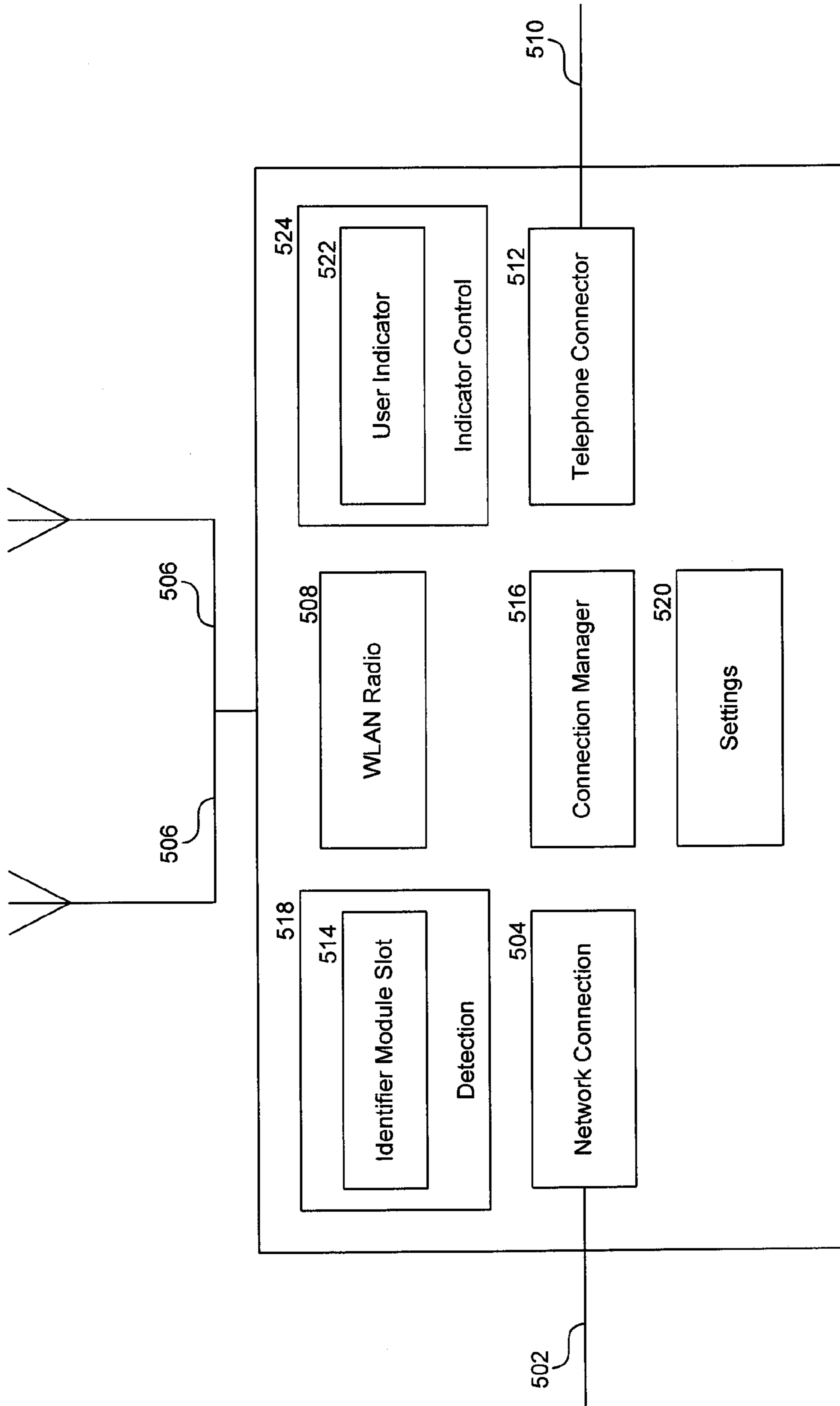
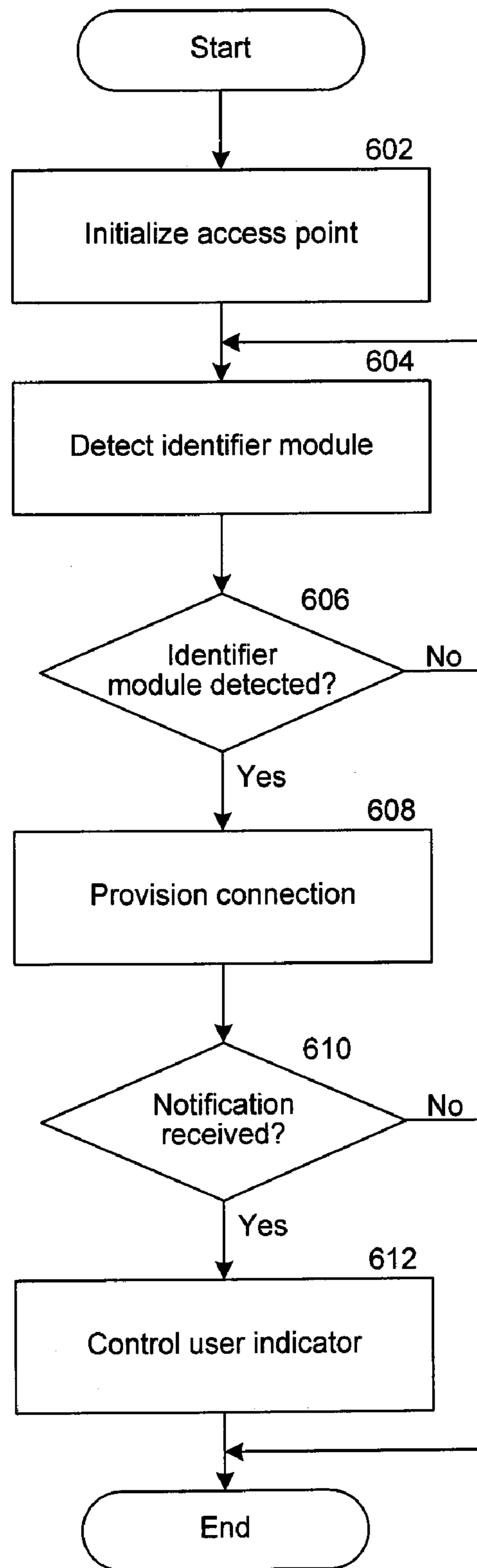


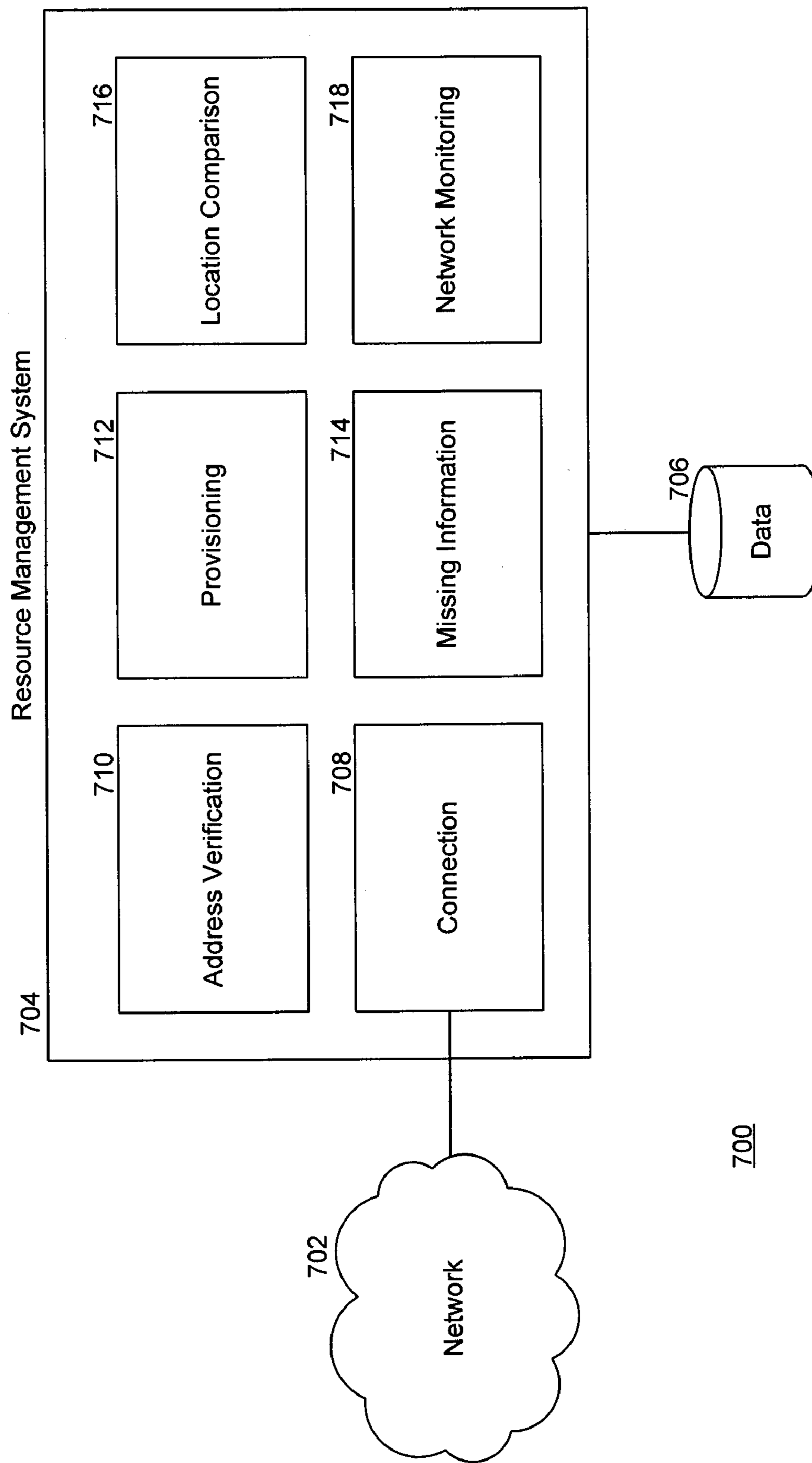
FIG. 5

226



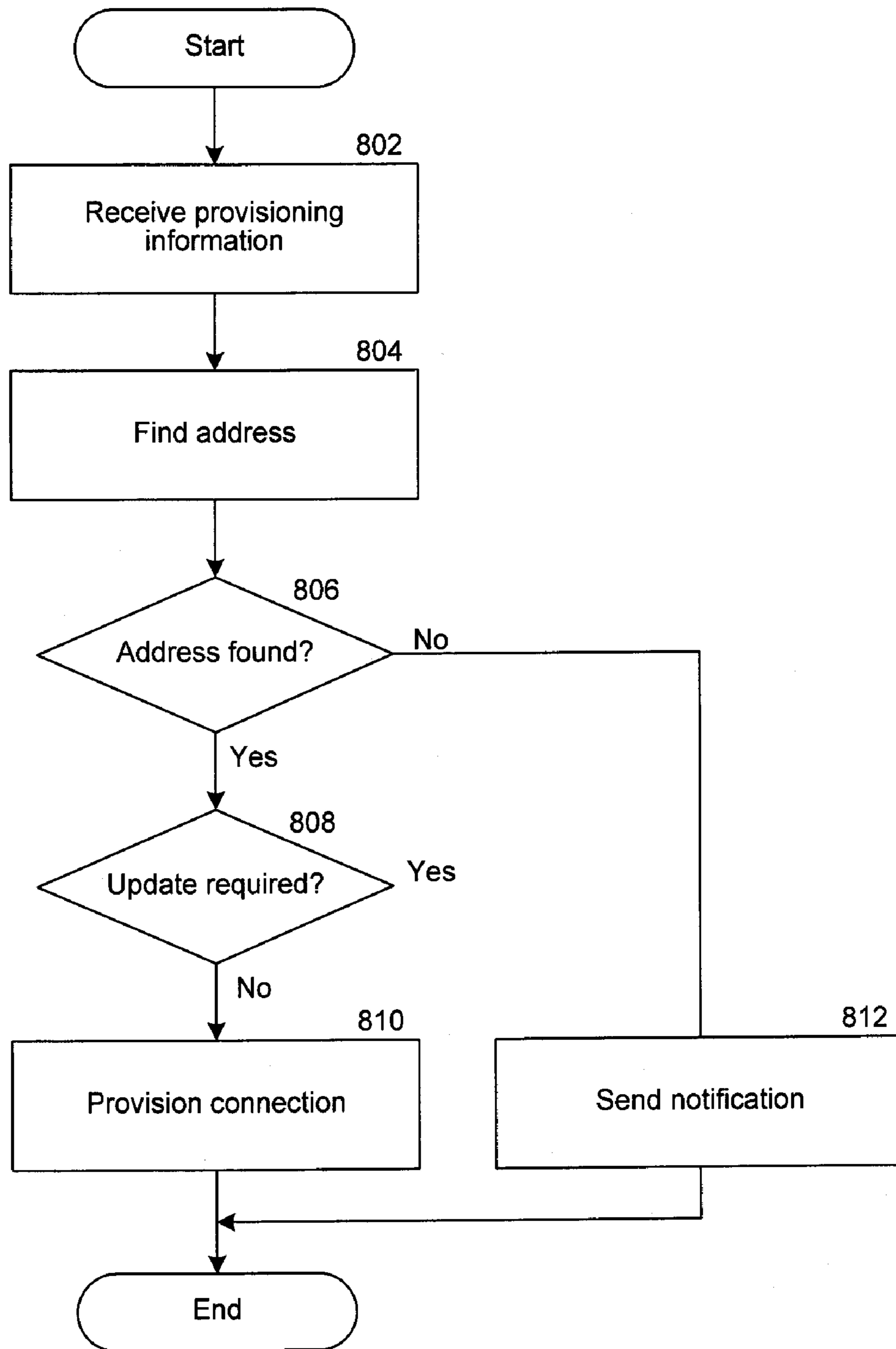
600

**FIG. 6**



**FIG. 7**





800

**FIG. 8**

## 1

**SYSTEM AND METHOD FOR  
PROVISIONING TELECOMMUNICATIONS  
SERVICES BETWEEN AN ACCESS POINT  
AND A TELECOMMUNICATIONS NETWORK  
AND PROVIDING A MISSING INFORMATION  
NOTIFICATION**

## BACKGROUND

In this digital age, modern telecommunications service providers and device manufacturers are increasingly relying on public and/or private Internet Protocol (IP) networks, including the Internet, as a core part of their technology. For example, many telecommunications service providers now offer a suite of Voice over Internet Protocol (VoIP) services, as well as various data services, that utilize IP networks and/or IP-based wireless access networks for at least part of their infrastructure. For example, these IP-based wireless access networks may be based on IEEE 802.16 (WiMAX), IEEE 802.20 Mobile Broadband Wireless Access (MBWA), Ultra Wideband (UWB), 802.11 wireless fidelity (Wi-Fi), Bluetooth, and similar standards. Likewise, device manufacturers are producing a new generation of mobile devices, such as wireless handhelds, wireless handsets, mobile phones, personal digital assistants, notebook computers, and similar devices. These devices are enabled to send and receive information using IP-based telecommunications services. In fact, many of today's modern mobile devices are able to function as "dual-mode devices" that take advantage of both cellular network technologies and IP-based technologies.

Unlicensed Mobile Access (UMA) technology has developed as part of this trend to incorporate IP solutions into mobile device telecommunications systems. UMA technology has been accepted into Release 6 of the 3rd Generation Partnership Project (3GPP) and is also referred to as Generic Access Network (GAN) technology. In various implementation schemes, UMA allows wireless service providers to merge cellular networks (such as Global System for Mobile Communications (GSM) networks) and IP-based wireless networks into one seamless service (with one mobile device, one user interface, and a common set of network services for both voice and data). One goal of UMA is to allow subscribers to move transparently between cellular networks and IP-based wireless networks with seamless voice and data session continuity, similar to the way that they can transparently move between cells within the cellular network. Seamless in-call handover between the IP-based wireless network and the cellular network ensures that the user's location and mobility do not affect the services delivered to the user.

At an operational level, UMA technology effectively creates a parallel radio access network, the UMA network, which interfaces with the mobile core network using standard mobility-enabled interfaces. For example, UMA can replace a system's GSM radio technology on the lower protocol layers with a wireless Local Area Network (LAN), or similar technology. A call or other communication may be tunneled to the Mobile Switching Center (MSC) of a mobile service provider via an access point (e.g., a Wi-Fi access point or a femtocell connected to a modem via the Internet) and gateway (e.g., a UMA network controller). In many cases, the mobile core network remains unchanged, making it much easier to maintain full service and operational transparency and allowing other aspects of the service infrastructure to remain in place. For example, in many systems that utilize UMA, the existing service provider's business support systems (BSS), service delivery systems, content services, regulatory compliance systems, and operation support systems

## 2

(OSS) can support the UMA network without change. Likewise, service enhancements and technology evolution of the mobile core network apply transparently to both cellular access and UMA.

## BRIEF DESCRIPTION OF THE DRAWINGS

FIG. 1 illustrates aspects of a sample network system that allows VoIP-based communications in conjunction with a public switched telephone network (PSTN).

FIG. 2 illustrates a sample converged wireless network system that combines a cellular network with an IP-based wireless telecommunications network.

FIG. 3 illustrates the back panel of an access point capable of supporting two landline telephones in addition to a wireless connection.

FIG. 4 illustrates a timing diagram of actions in a UMA network for provisioning telecommunications services.

FIG. 5 illustrates a block diagram of an access point capable of selectively provisioning a connection for a landline telephone.

FIG. 6 illustrates a process for selectively provisioning telecommunications services between a landline telephone and an IP-based network.

FIG. 7 illustrates a logical block diagram of a system for provisioning telecommunications services in response to a request received from an access point.

FIG. 8 illustrates a process for provisioning telecommunications services in response to a request received from an access point.

## DETAILED DESCRIPTION

The following description provides specific details for a thorough understanding of, and enabling description for, various embodiments of the technology. One skilled in the art will understand that the technology may be practiced without these details. In some instances, well-known structures and functions have not been shown or described in detail to avoid unnecessarily obscuring the description of the embodiments of the technology. It is intended that the terminology used in the description presented below be interpreted in its broadest reasonable manner, even though it is being used in conjunction with a detailed description of certain embodiments of the technology. Although certain terms may be emphasized below, any terminology intended to be interpreted in any restricted manner will be overtly and specifically defined as such in this Detailed Description.

## I. SAMPLE NETWORK CONFIGURATIONS

FIG. 1 illustrates aspects of a sample network system **100**, including multiple telecommunications networks, that allows VoIP-based communications in conjunction with a public switched telephone network (PSTN) **102**. As discussed herein, a telecommunications network may include any network suitable for enabling transmission of signals over a distance. Thus, the telecommunications networks discussed may be wired or wireless, circuit-switched or packet-switched, and may use licensed, semilicensed, or unlicensed wireless bands. The network system **100** includes at least one access point **104**. The access point **104** may be public or private and may be located, for example, in a subscriber's residence (e.g., home, apartment, or other residence), in a public location (e.g., coffee shops, retail stores, libraries, or schools), or in corporate or other private locations. In the sample system of FIG. 1, the access point **104** can accept

communications **106** from at least one suitably configured telecommunications device **108** (e.g., a VoIP device). Various examples of network technology that may be involved in communicating between the telecommunications device **108** and the access point **104** include the IEEE 802.16 (WiMAX), IEEE 802.20 Mobile Broadband Wireless Access (MBWA), Ultra Wideband (UWB), 802.11 wireless fidelity (Wi-Fi), and Bluetooth standards, or other similar standards. The access point **104** includes a wireless router **110** and a broadband modem **112** that enable connection to an Internet Protocol (IP) network **114**. The IP network **114** may comprise one or more public networks or private networks, or a combination of public and private networks.

Through communications **106**, the access point **104** receives IP packets from the telecommunications device **108**. These IP packets are then transported through the IP network **114** to a signaling gateway **116**, which in the example of FIG. 1 is operated by a telecommunications service provider. At the signaling gateway **116**, the IP packets are converted to a traditional phone service signal. The phone service signal is then conveyed to a recipient via the PSTN **102**.

The network system **100** of FIG. 1 also includes a call controller **118** that provides call logic and call control functions for communications sent through the system and an application server **120** that provides logic and execution of one or more applications or services offered by the telecommunications service provider, such as applications that implement various access and security rules. In this example, a telecommunications service provider manages both the call controller **118** and the application server **120**.

FIG. 2 illustrates a sample converged wireless network system that combines a cellular network with an IP-based wireless telecommunications network. In general, with respect to the network system described in FIG. 2, because the same cellular protocols are used in communications involving IP access points as with traditional radio towers, the cellular service provider maintains a large degree of system compatibility even though it uses an IP-based network. For example, the various systems of the cellular service provider that deliver content and handle mobility may not even need to be aware that a subscriber's mobile device is on an IP-based wireless telecommunications network. Instead, the various systems of the cellular service provider assume that the mobile device is on its native cellular network. The IP network is, therefore, abstracted with respect to the cellular network, regardless of whether the mobile device connects to the cellular network via a base station (e.g., for licensed spectrum access) or a wireless access point (e.g., for licensed, semilicensed, and/or unlicensed spectrum access—such as spectrums for IP-based wireless telecommunications). Likewise, at a protocol level, because the same cellular protocols are used in communications involving the IP access points as with traditional radio towers, the cellular service provider maintains a large degree of system compatibility even though it uses an IP-based network.

Referring to FIG. 2, a sample network system **200** combines a cellular telephone network **202** (such as a GSM network) and an IP network **204** in a UMA-type configuration that provides service to the user of a mobile device **206** or a landline telephone **236**. Such service may include voice services and also supplementary services, such as call forwarding, call waiting, text messaging services (e.g., Short Message Service (SMS)), and data-based services like ringtone downloads, game downloads, picture messaging, email, and web browsing. Further, since the mobile device **206** is con-

nected to an IP network, all manner of data services available over such networks may be provided to the mobile device **206**.

In general, the described network system **200** accepts registration requests from the mobile device **206**. The accepted registration requests can be requests to either the cellular telephone network **202** or to the IP network **204**. Accordingly, to handle requests to the cellular telephone network **202**, the cellular telephone network **202** includes one or more cell towers **208** that are configured to accept cellular communications **210** from the mobile device **206**. The cell towers **208** are connected to a base station controller **212** (such as a base station controller/radio network controller (BSC/RNC)) via a private network **214**. The private network **214** can include a variety of connections (not shown) such as T1 lines, a wide area network (WAN), a local area network (LAN), various network switches, and other similar components.

The base station controller **212** controls communication traffic to a carrier network **216**, where all communications are managed (including both cellular and IP-based communications). Components of the carrier network **216** in this example include a switch (e.g., a mobile switching center (MSC)) **218**, which is configured to control data/call flows and perform load balancing, as well as other functions. The carrier network **216** may also include a variety of system databases, such as an operation support subsystem (OSS) database **220**, a business support system (BSS) database **222**, and a home location register (HLR) **224**, or other central subscriber database that contains details of a carrier's subscribers for billing, call logging, etc.

The sample network system **200** further includes one or more access points **226** that can accept IP-based communications **228** from the mobile device **206**. For example, each access point **226** can be configured as part of a network in one or more locations such as a public network **230**, a home network **232**, or a private business network **234**. Each access point **226** is coupled to the IP network **204** through, for example, a broadband connection (not shown), such as a Digital Subscriber Line (DSL) modem, a cable modem, a satellite modem, or any other broadband device. The access points may communicate with mobile devices wirelessly via any licensed, semilicensed or unlicensed spectrum (e.g., a WiFi access point or a femtocell access point), or may provide only wired communication.

The access points **226** may be configured to provide telecommunications services to any type of customer-premises equipment (CPE). As used herein, a CPE is any terminal or equipment located at a subscriber's premises (e.g. in a home or office) and connected with a carrier telecommunications network. CPE may include, for example, a landline telephone, a cordless telephone, a mobile device operating within the home, a broadband modem, or a set-top box.

In one configuration, the access points **226** may be configured with one or more landline telephone connectors. For example, FIG. 3 illustrates the back panel of an access point **226** capable of supporting two landline telephones (e.g., traditional landline telephones and cordless telephones) in addition to a wireless connection. The access point **226** includes a WAN connector **304**, which connects the access point **226** to the IP network **204**. The access point **226** also includes a plurality of data connectors **306** that connect to computers or other devices and are used to carry data traffic. The access point **226** may have one or more antennas **308** that support wireless connections for data transmission, such as for an IP-based telecommunications connection. Alternatively, the access point **226** may have no antennas and may only support wired connections. The access point **226** also includes two

5

telephone connectors **302**, which can accept a cable connecting to a landline telephone. In most cases, this is implemented as an RJ-11 connector, but one skilled in the art will appreciate that other standard connectors could be used, including an RJ-14, RJ-25, or RJ-45 connector. The access point **226** may also include a port, slot, or socket (shown in FIG. **5**) configured to accept an identifier module that stores data associated with a subscriber or a voice connection, such as a subscriber identifier (e.g., an International Mobile Subscriber Identifier (IMSI)). The access point **226** may also support an alternate identifier, such as a software Subscriber Identity Module (SIM) or other identifier. The identifier module may include a tamper-resistant memory that may store information used to enable a device to connect to the carrier network **216** and authenticate the device to the carrier network **216**. For example, the subscriber identifier may be a unique or rare secure identification number associated with a subscriber, an organization, or a calling plan. In a UMA system, the slot is configured to accept a SIM card similar to those used for GSM mobile devices. The access point **226** may include a separate slot for each telephone connector **302** to allow each landline telephone **236** to be separately authorized.

Alternatively, the telephone connectors **302** may be implemented as a local wireless connection using licensed, semi-licensed, or unlicensed wireless bands. For example, the access point **226** may include a radio as the telephone connector, which is configured to communicate directly with a cordless telephone handset using an unlicensed wireless band. Alternatively or additionally, the access point **226** may communicate with a mobile device (e.g., a cellular telephone or smartphone) using a licensed band. In either configuration, the access point **226** may then be configured to provide telecommunications services using connection information (e.g., telephone number, subscriber identifier, etc.) associated with the access point **226**, rather than connection information associated with the cordless telephone handset/mobile device/etc. This implementation has the advantage of allowing a user to use a cordless telephone handset without requiring a separate base station. It also allows a user to use a mobile device as a handset even if the mobile device is not configured to directly connect to the carrier network.

The access point **226** may also include one or more user indicators to provide status information or error notifications to a user (shown in FIG. **5**). For example, the access point **226** may provide information by enabling, disabling, or changing a color of one or more indicator lights **310**. Alternatively, the access point **226** may include a display screen (e.g., an LCD screen) capable of displaying text describing status or error conditions. The access point **226** may also provide other user-perceptible indicators, such as an audible indicator.

Returning to FIG. **2**, the landline telephone **236** is connected to the access point **226** with a standard wired connection **238** to one of the telephone connectors **302**. In this configuration, the access point **226** converts the incoming analog voice signal into digital form and encapsulates the signal for transmission over the IP network **204**. As discussed below, the access point **226** also communicates with a security gateway **240** or a network controller **242** to enable the landline telephone to make calls through the carrier network **216**. The access point **226** is generally configured to provision a separate connection for each telephone connector **302**.

In some configurations, the access point **226** includes components to provide the connected landline telephone **236** with a simulation of a Plain Old Telephone Service (POTS) network. For example, the access point **226** may act as a POTS end office by providing a dial tone when the user lifts the telephone off the hook if there is a connection to the carrier

6

network. The access point may also provide the calling name and number for an incoming call by translating the data from the IP-based telecommunications format to the format used by a POTS caller ID service. It may similarly provide the ability to toggle between calls for call waiting using the standard flash hook by translating the POTS signal into the equivalent UMA or GSM format. The access point **226** may also provide a standard POTS stutter dial tone to indicate new voice mail. The access point **226** could do this by periodically querying the carrier network **216** to determine whether new voice mail is available and providing the stutter dial tone if the carrier network indicates that there is new voice mail. Alternatively, or in addition to the stutter dial tone, the access point **226** may include an indicator (e.g. a flashing light) to notify the user that new voice mail is available.

When the mobile device **206** attempts to access the IP network **204** (i.e., to initiate an IP-based communication), information (e.g., data, voice, SMS, etc.) is initially formatted in the native protocol of the cellular telephone network **202** and then encapsulated into IP packets, which are transmitted to the access point **226** and routed through the IP network **204** to the security gateway **240**. In contrast to non-IP communication requests, such transmissions bypass the existing network of radio towers of the cellular telephone network **202**. Similarly, when the landline telephone **236** attempts to make a call through the IP network **204**, the access point **226** encapsulates the voice signal into IP packets that are then routed through the IP network **204** to the security gateway **240**. The security gateway **240** controls access to the network controller **242**, which communicates with a data store **246** used to log and access communications data. Thus, one function of the network controller **242** is to manage access to the carrier network **216** when dealing with an IP-based communication (in a similar manner that the base station controller **212** does for a non-IP-based communication).

In one example, authentication of a request for access by the mobile device **206** or the access point **226** over the IP network **204** is handled by the security gateway **240**, which communicates with an authentication, access, and authorization (AAA) module **244** that is most likely associated with the carrier network **216**. Challenges and responses to requests for access by the mobile device **206** or the access point **226** are communicated between the HLR **224** and the AAA module **244**. When authorization is granted, the security gateway **240** communicates the assignment of an IP address to the mobile device **206** or the access point **226** that requested access. Once the security gateway **240** passes the IP address to the mobile device **206** or the access point **226**, the public IP address assigned to the device is passed to the network controller **242**.

In another authorization example, upon receiving identification information from the mobile device **206**, the network controller **242** may query the data store **246** to determine whether the mobile device **206** is authorized to access the IP network **204**. Sample identifiers that may be utilized to determine whether access should be granted include a media access control (MAC) address associated with an access point, a mobile device or subscriber identifier (such as an IMSI), an IP address (or "Public IP address") associated with the access point, a fully qualified domain name (FQDN), or other similar types of information. The data store **246** may be a single database, table, or list, or a combination of databases, tables, or lists, such as one for IP addresses **248**, one for MAC addresses **250**, one for subscriber identifiers **252**, and one for FQDNs **254**. The data store **246** may include "blocked" identifiers as well as "authorized" identifiers. Authorized accesses to the IP-based wireless telecommunications network may be

maintained by the network controller **242** in an authorized session table or similar data construct.

In some cases, the signaling portion of a communication (e.g., the portion of the communication that governs various overhead aspects of the communication such as, for example, when the call starts, when the call stops, initiating a telephone ring, etc.) is routed through the network controller **242** to the switch **218**, while the voice bearer portion of the communication (e.g., the portion of the communication that contains the actual content (either data or voice information) of the communication) is routed through the network controller **242** to a media gateway **256**. In other words, the media gateway **256** controls the content flow between the service provider and the mobile device **206**, while the switch **218** controls the signaling flow (or controls the overhead-related flow) between the service provider and the mobile device **206**.

FIG. **4** illustrates an example of a timing diagram **400** of steps in a UMA network for provisioning telecommunications services, including registering a mobile device and facilitating a call from the mobile device **206**. However, as noted herein, the disclosed system is not limited to UMA services and may include any other service suitable for provisioning telecommunications services. For example, the disclosed system may also be configured to provide access using licensed frequency bands. The call registration process is illustrated by communication steps **402-412**, while the calling process is illustrated by communication steps **414-422**. The steps of the timing diagram **400** may also be used to support calls from the landline telephone **236** connected to the access point **226**. In those cases, the registration and calling processes are initiated by the access point **226**, rather than the mobile device **206**.

At step **402**, the mobile device **206** or the access point **226** initiates a call by sending a request to register to the security gateway **240**. The security gateway **240** replies with an authentication challenge communicated back to the mobile device **206** or access point **226** at step **404**. At step **406**, the mobile device **206** or access point **226** responds to the authentication challenge with a response communicated to the security gateway **240**. Also at step **406**, the security gateway **240** communicates a public IP address that is assigned to the access point **226** to the network controller **242**. At step **408**, the mobile device **206** communicates an identifier (such as the IMSI ID) and a Cell Global Identifier (CGI) record (CGI<sub>REAL</sub>) to the security gateway **240**. The CGI record is an identifier that uniquely identifies a base station initiating a call through the core network. In a UMA connection from a mobile device **206**, CGI<sub>REAL</sub> is the CGI record for the nearest cell tower **208**. For a connection from an access point **226**, CGI<sub>REAL</sub> may be a hard-coded value unique to the access point **226** or may be selected based on other criteria, such as geographic location. Also at step **408**, the security gateway **240** transmits the subscriber identifier, CGI<sub>REAL</sub>, and the MAC address (MAC<sub>AP</sub>) from the access point **226** to the network controller **242**. In response, the network controller **242** communicates with the data store **246**, which replies with CGI<sub>BILLING</sub> at step **410**. CGI<sub>BILLING</sub> is used by the network to ensure that the call is billed correctly.

The network controller **242** may also perform other types of authentication during this step. For example, current Federal Communications Commission regulations require that VoIP connections must be associated with a physical or geographic address (e.g., a street address) in order to enable enhanced 911 emergency services (E911). Thus, the network controller **242** may also confirm that the data store **246** includes an E911 address for the access point **226** before allowing the voice connection. For example, the network

controller **242** may use the subscriber identifier as an index to look up an E911 address and reject the connection if no address is found. In some implementations, when provisioning a connection from a mobile device, the network controller **242** may use identifying information associated with the access point (e.g., the MAC address) to find the E911 address.

At step **412**, the network controller **242** communicates a registration completion message to the mobile device **206**. If the connection is rejected, the network controller **242** responds with a rejection message. In particular, if an E911 address was not found, the network controller **242** provides a missing information notification message informing the access point **226** that required information was not found. In a UMA or GAN system, the missing information notification message is a geolocation unknown message.

Once the registration is completed, the mobile device **206** or the access point **226** communicates with the network controller **242** to request a call at step **414**. At step **416**, the network controller **242** communicates the subscriber identifier and CGI<sub>BILLING</sub> to the switch **218**. The switch **218** authorizes the call at step **418** such that the device can communicate over a communication channel established through the switch **218** at step **420**. At step **422**, the call is terminated and the switch **218** communicates a call data record (CDR) to the billing system (e.g., the BSS database **222**).

## II. SELECTIVELY PROVISIONING CONNECTIONS BETWEEN THE ACCESS POINT AND THE NETWORK

A method and system for selectively provisioning connections between an access point and the carrier network is disclosed. The access point **226** can be used to provision a connection for a landline telephone, a cordless telephone, or any mobile device. The access point **226** sends a provisioning request that includes identifying information such as a subscriber identifier and a MAC address, to the network controller **242**. The network controller **242** attempts to find a geographic address associated with the connection to be provisioned. If an address is not found, the network controller **242** rejects the connection and sends a missing information notification to the access point **226**. After receiving the missing information notification, the access point **226** controls a user indicator (e.g., an indicator light, a display screen, an audible indicator, etc.) to provide error information. A user can use the error information to more quickly troubleshoot connection problems.

FIG. **5** illustrates a block diagram of an access point **226** capable of selectively provisioning a connection for a landline telephone **236**. The access point **226** includes a network connection component **504** that provides an interface between the access point **226** and the IP network **204**. The network connection component **504** is connected to the network through a network connection **502**, which may be a hardwired connection (e.g., a cable or DSL connection) or a wireless connection (e.g., a WiMAX connection). The network connection component **504** may be of any type known in the art, such as an Ethernet network chip. The connection is supported by a standard network protocol stack, such as a TCP/IP stack (not shown). Similarly, the access point **226** includes a telephone connector component **512**, which is connected to a telephone cord **510**. The telephone connector component **512** receives a landline telephone signal through the telephone cord **510** and passes it to other processing components (not shown). Alternatively, the telephone connector **512** may be a wireless connection using unlicensed spectrum to connect to a cordless phone or a mobile device.

The other processing components can include, for example, a component to convert the analog signal into a digital form and encapsulate the data for transmission. The access point **226** may also have a wireless LAN (WLAN) radio component **508**, which is connected to one or more antennas **506**. The WLAN radio component **508** provides wireless networking support to enable mobile devices **206** to connect as described above. The access point **226** may include other radio components instead of, or in addition to, the WLAN radio component **508**. For example, the access point **226** may include radio components capable of operating in licensed frequency bands using wireless standards such as GSM or CDMA2000. The access point **226** may also include radio components capable of operating in unlicensed frequency bands using other wireless standards, such as UWB or Digital Enhanced Cordless Telecommunications (DECT). The access point **226** may also have an identifier module slot **514**, which is configured to receive an identifier module having a tamper-resistant memory. The tamper-resistant memory stores subscriber or connection-specific data. In one implementation, this could include a SIM card similar to the cards used in, e.g., a GSM mobile device. Alternatively, the access point **226** may have a software SIM incorporating an IMSI or other identifier. The access point **226** also includes a settings component **520**, which stores configuration settings for the access point **226**, such as security settings and the IP address of the security gateway **240**.

The identifier module includes information that defines the subscriber's identity. The identity could include any of the identification information described above, such as subscriber identifier (e.g., IMSI, mobile identifier number (MIN), or similar identifiers), equipment identifiers (e.g., MAC address, electronic serial number (ESN), or similar identifiers), FQDN, IP address, or a combination of these. The identity could also be defined by a value algorithmically generated from the identification information, such as the exclusive OR, addition, or concatenation of two or more numbers.

The identifier module slot **514** is associated with a detection component **518**, which uses electrical or mechanical means to determine whether an identifier module is present in the identifier module slot **514**. Further details may be found in assignee's co-pending U.S. application Ser. No. 12/175,414, entitled "SYSTEM AND METHOD FOR SELECTIVELY PROVISIONING TELECOMMUNICATIONS SERVICES BETWEEN AN ACCESS POINT AND A TELECOMMUNICATIONS NETWORK USING A SUBSCRIBER IDENTIFIER," which is hereby incorporated by reference.

The access point **226** also has a connection manager component **516**. The connection manager component **516** provisions call connections between the access point **226** and the carrier network **216** when the access point **226** determines that the connection should be set up. The connection manager **516** executes the call setup steps described above for FIGS. 1-4, such as contacting the security gateway **240**. In a UMA network, the connection manager component **516** implements a UMA client for connecting with the carrier network **216**.

The access point **226** also includes a user indicator component **522**. As discussed above with reference to FIG. 3, the user indicator component **522** may include one or more indicator lights, a display screen, an audible indicator, or any other component suitable for producing a user-perceptible notification. For example, the indicator component may be a single or multicolor LED, an iconic or alphanumeric LCD display (e.g., one or more rows or individual alphanumeric displays, such as a single row displaying a scrolling line of

text), an Organic Light Emitting Diode (OLED) display, a projection display, a Cathode Ray Tube (CRT) display, a plasma display, a Liquid Crystal on Silicon (LCoS) display, or a laser display. The indicator component may also include an audible component, such as a speaker, an electrical or electromechanical horn, or a bell. The user indicator component **522** is controlled by an indicator control component **524**, which is configured to control the user indicator component **522** to provide status or error information to a user. The indicator control component **524** may be implemented as software or firmware executed by a processor that receives the missing information notification and provides a signal to control the user indicator component **522**. In particular, the indicator control component **524** may control the user indicator component **522** to provide an error message in response to receiving a missing information notification from the network controller **242** in response to a provisioning request. Alternatively, the indicator control component **524** may control the user indicator component **522** to provide a simple error notification having a predefined meaning (e.g., a bell noise, a change in the color of an indicator LED). Thus, an existing visual indicator, e.g., power LED, may turn color or flash in response to the missing information notification.

FIG. 6 illustrates a process **600** for selectively provisioning a connection between a landline telephone and an IP-based network. The process begins at block **602**, where the access point starts up and initializes. During this step, the access point **226** executes initialization tasks, such as initiating the WLAN radio component **508** to provide wireless networking and the data connectors **306** to provide wired data networking. In this step, the access point **226** also determines whether it is connected to the IP network **204** through the network connection component **504**. This may include detecting a physical connection to the WAN connector **304** or determining whether the access point **226** has an IP address for the WAN connection.

Once the access point **226** is running and the above (optional) checks are performed, the system proceeds to block **604**, where it attempts to detect an identifier module in the identifier module slot **514** using any method known in the art, such as the methods discussed above. Alternatively, the system attempts to determine another identifier from, for instance, a software SIM. The system then proceeds to decision block **606**, where the system selects a processing branch depending on whether the detection component **518** found an identifier module. If an identifier was detected, the system proceeds to block **608**, where the connection manager component **516** sends a request to provision the connection. If a telephone connection was not detected, the system returns to block **604**, where it again attempts to detect the identifier module. If the connection is being provisioned for a mobile device, the system may instead use the subscriber identifier associated with the mobile device. In this case, the system may verify that the mobile device provided the subscriber identifier rather than attempt to find the identifier module in the access point **226**.

As noted above, in addition to detecting an identifier module in the identifier module slot **514**, the system in step **606** may perform other checks. For example, the access point may transmit the stored subscriber identifier (e.g., IMSI) to the network for validation. Alternatively or additionally, the network may confirm that a street address is associated with the access point (e.g., by comparing the IMSI to a stored record for an address associated with that IMSI) for E911 validation. In some configurations, the access point **226** does not perform these checks and proceeds directly to decision block **610** after initialization is complete.

Processing then proceeds to decision block **610**, where the system determines if a missing information notification was received in response to the provisioning request. As discussed in greater detail below, the network provides a missing information notification in response to a provisioning request from a device that does not have an associated street, geographic, or E911 address stored in a network database. If a missing information notification is received, processing proceeds to block **612**, where the system controls the user indicator. This may include enabling, disabling, or changing the color of one or more indicator lights in a predetermined way to indicate the error. Alternatively, the system may provide a text message to a display screen in response to receiving the missing information notification. The text may provide user instructions (e.g., text directing the user to call a customer service telephone number or access a specified network location via a displayed URL) or otherwise indicate to the user the nature of the problem and/or describe how to correct the problem. After controlling the user indicator, or if a notification was not received, the process exits.

FIG. 7 illustrates a logical block diagram of a system **700** for provisioning telecommunications services in response to a request received from the access point **226**. FIG. 7 and the following discussion provide a brief, general description of a suitable computing environment in which this aspect of the system can be implemented. Although not required, aspects of the system are described in the general context of computer-executable instructions, such as routines executed by a general-purpose data processing device, e.g., a server computer, wireless device, or personal computer. Those skilled in the relevant art will appreciate that aspects of the system can be practiced with other communications, data processing, or computer system configurations, including Internet appliances, handheld devices (including personal digital assistants (PDAs)), wearable computers, all manner of cellular or mobile phones, multiprocessor systems, microprocessor-based or programmable consumer electronics, set-top boxes, network PCs, mini-computers, mainframe computers, and the like. Indeed, the terms “computer,” “server,” “host,” “host system,” and the like are generally used interchangeably and refer to any of the above devices and systems, as well as any data processor.

Aspects of the system can be embodied in a special purpose computer or data processor that is specifically programmed, configured, or constructed to perform one or more of the computer-executable instructions explained in detail herein. While aspects of the system, such as certain functions, are described as being performed exclusively on a single device, the system can also be implemented in distributed environments where functions or modules are shared among disparate processing devices, which are linked through a communications network, such as a LAN, a WAN, or the Internet. In a distributed computing environment, program modules may be located in both local and remote memory storage devices.

Aspects of the system may be stored or distributed on tangible computer-readable media, including magnetically or optically readable computer discs, hard-wired or preprogrammed chips (e.g., EEPROM semiconductor chips), nanotechnology memory, biological memory, or other data storage media. Alternatively, computer-implemented instructions, data structures, screen displays, and other data under aspects of the system may be distributed over the Internet or over other networks (including wireless networks), on a propagated signal on a propagation medium (e.g., an electromagnetic wave(s), a sound wave, etc.) over a period of time, or they may be provided on any analog or digital network (packet switched, circuit switched, or other scheme).

FIG. 7 includes a resource management system **704**, which is configured to receive provisioning requests from the access point **226** and selectively allocate resources in response to the provisioning requests. The resource management system **704** may be located, for example, in the network controller **242** of FIG. 2. The resource management system **704** is connected to a data component **706**, which stores subscriber information, such as addresses associated with individual subscribers. The data component **706** may be, for example, the data store **246** of FIG. 2.

The resource management system **704** includes a connection component **708**, which is configured to provide a data connection to a data network **702**, such as the IP network **204** of FIG. 2. The connection component **708**, which may be an IP gateway, receives requests from the mobile device **206** or the access point **226** to register and provision a connection through the IP network **204**. As discussed above with reference to FIG. 4, such requests may include the subscriber identifier (e.g., IMSI), the MAC, and the  $CGI_{REAL}$  of the device sending the request. The connection component **708** provides provisioning request information to an address verification component **710**, which is configured to find a geographic address associated with the request information. The system may determine the address based on identifying information, such as the subscriber identifier or the MAC.

The resource management system **704** also includes a provisioning component **712**, which is configured to selectively provision telecommunications services from the mobile device **206** or the access point **226** through the IP network **204**. As discussed in detail below, the provisioning process may include provisioning or rejecting a resource request based on whether a matching address was found by the address verification component **710**. A missing information component **714** is configured to send a missing information notification to the access point **226** if the address verification component **710** did not find a matching address.

In some implementations, the system may attempt to determine if the address determined by the address verification component **710** is out of date. For example, the access point **226** may include a component for determining its current geographic location (e.g., a Global Positioning System (GPS) receiver). The access point **226** may provide the geographic location information in the provisioning request. A location comparison component **716** compares the geographic location information to the geographic address stored in the database. If the locations differ by greater than a threshold amount (e.g., 0.5 miles), the system may determine that the stored address is no longer accurate and send a missing information notification. Similarly, the system **700** may also include a network monitoring component **718**, which is configured to monitor a network address (e.g., an IP address) associated with the access point **226** over a period of time. If the network address changes significantly, the system may determine that the stored geographic address is no longer accurate and send a missing information notification.

FIG. 8 illustrates a process **800** for provisioning telecommunications services in response to a request received from the access point **226**. The process begins at block **802**, where the system receives provisioning information from the access point **226**. The system then proceeds to block **804**, where it attempts to find an address associated with the received information. As discussed above, this may include looking up the subscriber identifier or MAC address in a database such as the data store **246** of FIG. 2. Processing then proceeds to decision block **806**, where the system determines if the address was found. If the address was found, processing proceeds to decision block **808**, where the system determines if the address

must be updated (based on, e.g., comparing the geographic location information to the address or detecting a change in the network address associated with the access point 226). If the address was not found or if the address must be updated, the system proceeds to block 812, where it sends a missing information notification to the access point 226. Otherwise, the system proceeds to block 810, where it provisions the connection and notifies the access point 226 that the provisioning was successful. After notifying the access point 226, the process exits.

Many other alternatives or additions are possible. For example, as shown in FIG. 3, the access point 226 may have two or more telephone connectors 302. In this configuration, the access point 226 provisions connections for each connector separately. Similarly, the access point 226 may contain an identifier module slot 514 for each telephone connector 302. The access point 226 then uses each identifier module to authorize the connection separately. Thus, the access point 226 may execute the detection and provisioning steps of the method of FIG. 6 independently for each connector.

Alternatively or additionally, the subscriber identifier may be provided to the network via a means different from a physical identifier module inserted into the access point. For example, the landline phone 236 may use the identifier module slot 514 to receive the identifier module and communicate the IMSI or other data stored therein to the access point 226 when the phone is connected to the access point 226 via telephone connector 302. As another example, the access point 226 may connect to a nearby identifier module that not only has tamper-resistant memory, but also has the capability to connect through a wired or wireless connection. In this example, the identifier module may be a Radio-Frequency Identifier (RFID) tag, or a read-only memory device with a small radio (e.g., Bluetooth or IEEE 802.11 radio), and the access point may include an appropriate reader, such as an RFID reader, Bluetooth radio, etc.

### III. CONCLUSION

Unless the context clearly requires otherwise, throughout the description and the claims, the words “comprise,” “comprising,” and the like, are to be construed in an inclusive sense, as opposed to an exclusive or exhaustive sense; that is to say, in the sense of “including, but not limited to.” As used herein, the terms “connected” or “coupled,” or any variant thereof, mean any connection or coupling, either direct or indirect, between two or more elements; the coupling or connection between the elements can be physical, logical, or a combination thereof. Additionally, the words “herein,” “above,” “below,” and words of similar import, when used in this application, shall refer to this application as a whole and not to any particular portions of this application. Where the context permits, words in the Detailed Description using the singular or plural number may also include the plural or singular number, respectively. The word “or,” in reference to a list of two or more items, covers all of the following interpretations of the word: any of the items in the list, all of the items in the list, and any combination of the items in the list.

The Detailed Description of embodiments of the system is not intended to be exhaustive or to limit the system to the precise form disclosed above. While specific embodiments of, and examples for, the system are described for illustrative purposes, various equivalent modifications are possible within the scope of the system, as those skilled in the relevant art will recognize. For example, while processes or blocks are presented in a given order, alternative embodiments may perform routines having steps, or employ systems having blocks,

in a different order, and some processes or blocks may be deleted, moved, added, subdivided, combined, and/or modified to provide alternative combinations or subcombinations. Each of these processes or blocks may be implemented in a variety of different ways. Also, while processes or blocks are at times shown as being performed in series, these processes or blocks may instead be performed in parallel or may be performed at different times. Further any specific numbers noted herein are only examples: alternative implementations may employ differing values or ranges. Those skilled in the art will also appreciate that the actual implementation of a database may take a variety of forms, and the term “database” is used herein in the generic sense to refer to any data structure that allows data to be stored and accessed, such as tables, linked lists, arrays, etc.

The teachings of the methods and system provided herein can be applied to other systems, not necessarily the system described above. The elements and acts of the various embodiments described above can be combined to provide further embodiments.

Any patents and applications and other references noted above, including any that may be listed in accompanying filing papers, are incorporated herein by reference. Aspects of the technology can be modified, if necessary, to employ the systems, functions, and concepts of the various references described above to provide yet further embodiments of the technology.

These and other changes can be made to the invention in light of the Detailed Description. While the above description describes certain embodiments of the technology and describes the best mode contemplated, no matter how detailed the above appears in text, the invention can be practiced in many ways. Details of the system may vary considerably in their implementation, while still being encompassed by the technology disclosed herein. As noted above, particular terminology used when describing certain features or aspects of the technology should not be taken to imply that the terminology is being redefined herein to be restricted to any specific characteristics, features, or aspects of the technology with which that terminology is associated. In general, the terms used in the following claims should not be construed to limit the invention to the specific embodiments disclosed in the specification, unless the above Detailed Description explicitly defines such terms. Accordingly, the actual scope of the invention encompasses not only the disclosed embodiments, but also all equivalent ways of practicing or implementing the invention under the claims.

While certain aspects of the technology are presented below in certain claim forms, the inventors contemplate the various aspects of the technology in any number of claim forms. For example, while only one aspect of the invention is recited as embodied in a computer-readable medium, other aspects may likewise be embodied in a computer-readable medium. Accordingly, the inventors reserve the right to add additional claims after filing the application to pursue such additional claim forms for other aspects of the technology.

We claim:

1. In a telecommunications network that employs both a licensed wireless cellular network and an IP-based network, a method for provisioning telecommunications services for a user of a telecommunications device, wherein the telecommunications services are provisioned in part between an access point and the IP-based network, the method comprising:
  - receiving a registration signal from the access point, wherein the registration signal includes a subscriber identifier, and wherein the access point is configured to



## 15

provide telecommunications services over the IP-based network for the mobile device;  
 determining if a street address is associated with the subscriber identifier;  
 selectively provisioning telecommunications services between the access point and the telecommunications network, based at least in part on whether the street address was found; but,  
 if the street address was not found, sending a missing information notification to the access point.

2. The method of claim 1, wherein the telecommunications services are Universal Mobile Access (UMA) or Generic Access Network (GAN) services.

3. The method of claim 1, further comprising:  
 receiving a geographic location of the access point;  
 comparing the geographic location to the street address;  
 and  
 providing the missing information notification based on the comparison.

4. The method of claim 1, further comprising:  
 monitoring a logical address of the access point; and  
 providing the missing information notification in response to a change in the logical address.

5. A system for provisioning telecommunications services between an access point and an IP-based network in a converged telecommunications network that employs both a cellular network and the IP-based network, the system comprising:

a communication component configured to receive a request from the access point for telecommunications services, wherein the request includes an identifier;  
 an address verification component configured to find an address associated with the identifier;  
 a provisioning component configured to selectively provision telecommunications services between the access point and the telecommunications network, based at least in part on the comparison; and  
 a missing information component configured to send a missing information notification to the access point.

6. The system of claim 5, wherein the access point is a wireless local area network (WLAN) access point having a landline telephone connector for connecting to a landline telephone, wherein the access point provides voice services under a Universal Mobile Access (UMA) or Generic Access Network (GAN) protocol, wherein the identifier is received or derived from a user-provided memory device that stores the identifier in a tamper-resistant memory, and wherein the access point is configured to provide a user-perceptible indication in response to receiving the missing information notification.

7. The system of claim 5, further comprising a location comparison component configured to receive a geographic location of the access point, wherein the missing information component is further configured to send the missing information notification based on a comparison of the geographic location and the address.

8. The system of claim 5, further comprising a network monitoring component configured to monitor a network address of the access point, wherein the missing information component is further configured to send the missing information notification in response to a change in the network address.

9. In a telecommunications system employing an IP-based network, a method for provisioning telecommunications services for a user of a customer-premises telecommunications equipment, wherein the telecommunications services are provisioned via the IP-based network, the method comprising:

## 16

receiving a registration signal from the customer-premises telecommunications equipment, wherein the registration signal includes an identifier;  
 searching for a street address associated with the identifier;  
 determining whether to require the street address to be updated; and,  
 if the street address is not found or if the street address requires updating, sending a missing information notification to the customer-premises telecommunications equipment.

10. The method of claim 9, wherein determining whether the street address requires updating comprises:

receiving a geographic location of the customer-premises telecommunications equipment;  
 comparing the geographic location to the street address;  
 and  
 providing the missing information notification based on the comparison.

11. The method of claim 9, wherein determining whether the street address requires updating comprises:

monitoring a logical address of the customer-premises telecommunications equipment; and  
 providing the missing information notification in response to a change in the logical address.

12. A tangible computer-readable medium storing instructions for provisioning telecommunications services for a user of a telecommunications device, wherein the telecommunications services are provisioned in part between an access point and an IP-based network, comprising:

receiving a registration signal from the access point, wherein the registration signal includes a subscriber identifier, and  
 wherein the access point is configured to provide telecommunications services over the IP-based network for the mobile device;  
 determining if a street address is associated with the subscriber identifier;  
 selectively provisioning telecommunications services between the access point and the telecommunications network, based at least in part on whether the street address was found; but,  
 if the street address was not found, sending a missing information notification to the access point.

13. The tangible computer-readable medium of claim 12, wherein the telecommunications services are Universal Mobile Access (UMA) or Generic Access Network (GAN) services.

14. The tangible computer-readable medium of claim 12, further comprising:

receiving a geographic location of the access point;  
 comparing the geographic location to the street address;  
 and  
 providing the missing information notification based on the comparison.

15. The tangible computer-readable medium of claim 12, further comprising:

monitoring a logical address of the access point; and  
 providing the missing information notification in response to a change in the logical address.

16. In a telecommunications network that employs both a licensed wireless cellular network and an IP-based network, a system for provisioning telecommunications services for a user of a telecommunications device, wherein the telecommunications services are provisioned in part between an access point and the IP-based network, the system comprising:

17

means for receiving a registration signal from the access point, wherein the registration signal includes a subscriber identifier, and

wherein the access point is configured to provide telecommunications services over the IP-based network for the mobile device;

means for determining if a street address is associated with the subscriber identifier;

means for selectively provisioning telecommunications services between the access point and the telecommunications network, based at least in part on whether the street address was found; and,

means for sending a missing information notification to the access point if the street address was not found.

**17.** The system of claim **16**, wherein the telecommunications services are Universal Mobile Access (UMA) or Generic Access Network (GAN) services.

**18.** The system of claim **16**, further comprising:

means for receiving a geographic location of the access point;

means for comparing the geographic location to the street address; and

means for providing the missing information notification based on the comparison.

**19.** The system of claim **16**, further comprising:

means for monitoring a logical address of the access point; and

means for providing the missing information notification in response to a change in the logical address.

**20.** A tangible computer-readable medium storing instructions for provisioning telecommunications services for a user

18

of a customer-premises telecommunications equipment, wherein the telecommunications services are provisioned via a IP-based network, the method comprising:

receiving a registration signal from the customer-premises telecommunications equipment,

wherein the registration signal includes an identifier;

searching for a street address associated with the identifier; determining whether to require the street address to be updated; and,

if the street address is not found or if the street address requires updating, sending a missing information notification to the customer-premises telecommunications equipment.

**21.** The tangible computer-readable medium of claim **20**, wherein determining whether the street address requires updating comprises:

receiving a geographic location of the customer-premises telecommunications equipment;

comparing the geographic location to the street address; and

providing the missing information notification based on the comparison.

**22.** The tangible computer-readable medium of claim **20**, wherein determining whether the street address requires updating comprises:

monitoring a logical address of the customer-premises telecommunications equipment; and

providing the missing information notification in response to a change in the logical address.

\* \* \* \* \*